

REMARKS

Claim 1 has been amended to place it in more correct idiomatic English but the scope remains the same. For convenience of the Examiner, discussion of the invention herein is made in conjunction with the numbered paragraphs of the published application of November 16, 2006.

It is important to remember that claim 1 is limited to the production of biodiesel and it is production of biodiesel from renewable fuels. Both are claim limitations. The problem confronted by the inventors is that conventional biodiesel which uses long chain fatty acid esters with renewable oils, produces low carbon alcohols and glycerine, both of which can kill or substantially shorten the life of enzymatic catalysts used in the system. To overcome this, the Applicant uses low carbon fatty acid esters (not long chain fatty acid esters) in performing a transesterification reaction with a renewable oil in the presence of the enzyme catalyst [0006], [0014]. Thus, neither the specific reaction nor the problem, nor overcoming the problem presented by the Applicants is taught or suggested by either the primary reference Mukherjee (see D1) or Wagner (D2) or these in combination with Shimada (D3). And if the problem is not suggested, nor the result achieved by the art, it cannot be an obvious invention.

Mukherjee relates to a method for enzymatic enrichment of very-long-chain monounsaturated fatty acids (VLCMFA, the chain is more than 20 carbon atoms) from natural resources by lipase-catalyzed reactions, and focuses on the study of selectivity of lipases (last paragraph, right column 2, page 557). In Mukherjee the transesterification reaction is carried out between triacylglycerols and alkyl acetates, such as ethyl, propyl and butyl acetate, in the presence of a lipase to produce alkyl esters (ethyl, propyl and butyl respectively) and a mixture of acetylacylglycerols as well as acylglycerols (third paragraph, left column, page 561).

As compared with claim 1 of the present application, Mukherjee does not provide any teachings or suggestions of producing biodiesel from renewable oils (the chain is of 18 carbon atoms or less) and low carbon fatty acid esters and further, Mukherjee says nothing of the recycled use of the by-product glycerine tri-(low carbon) carboxylic ester.

Wagner relates to the basic alcoholysis of ester, which is quite different from the enzymatic transesterification of the present invention, and thus Wagner is irrelevant to the present invention.

The Examiner contends that in view of Shimada, continual conversion of vegetable oil to the corresponding fatty acid methyl esters is a standard practice and "as such, Applicant's claimed second step that transesterified the glycerin produced by the first step and using it in a further round of biodiesel synthesis is especially obvious to an industrial level process". The Applicant respectfully does not agree with the Examiner in this regard.

Above all, the Applicant would like to point out that in the second step of the present invention, it is the by-product glycerine tri(low carbon) carboxylic ester instead of glycerin as stated by the Examiner that is tranesterified.

Shimada discloses a continuous production of biodiesel from vegetable oil and methanol by repeating a three-step reaction with stepwise addition of methanol (paragraph 3, right column, page 792). However, the so-called "continuous production" is totally different from the second step in present claim 1 that reacts the by-product glycerine tri-(low carbon) carboxylic ester with a low carbon alcohol R'OH to obtain the recycled low carbon fatty acid ester RCOOR'. Shimada uses methanol instead of glycerine tri-(low carbon) carboxylic ester is produced in Shimada only relates to repeating the three-step reaction with stepwise addition of methanol. In other words, Shimada does not teach or suggest the second step in claim 1 of the present application at all. So

a person skilled in the art cannot get any motivation from Shimada to combine the second step of the present invention with the first step in claim 1 of the present application.

Using methanol as the acyl acceptor during the preparation of biodiesel has several disadvantages: firstly, methanol is harmful to enzyme molecules and causes inactivation of the enzyme; moreover, glycerin is generated as a by-product, which is highly hydrophilic and with high viscosity, and it can easily adhere to the surface of the immobilized enzyme and tends to block the active sites of the immobilized enzyme and thus reduces the activity of the enzyme rapidly. So it is required to continuously remove the glycerin from the reaction system, which renders the process complicated and costly.

In the process claimed in claim 1 of the present application, in the first step, the low carbon fatty acid ester, which is used as the acyl acceptor, is not harmful to the enzyme catalyst and the by-product glycerine tri-(low carbon) carboxylic ester is not harmful to the enzyme catalyst either. Meanwhile, in the second step, the by-product glycerine tri-(low carbon) carboxylic ester is reacted with a low carbon alcohol $R'OH$ to obtain the recyclable low carbon fatty acid ester $RCOOR'$, and thus only at the very beginning of the continuous process a small batch of low carbon fatty acid ester $RCOOR'$ is used as raw material and then $R'OH$ is used to convert the by-product glycerine tri-(low carbon) carboxylic ester to $RCOOR'$ continuously and no more $RCOOR'$ is needed to add into the continuous process. That is, $R'OH$ can be used as the raw material for all of the rest process. Therefore, the second step in claim 1 of the present application greatly reduces the cost of the continuous process, which is comparable with the process of directly using low carbon alcohol as the acyl acceptor.

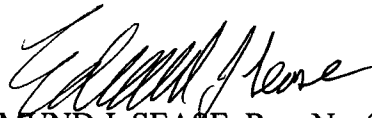
To sum up, none of Mukherjee, Wagner or Shimada teaches or suggests the first step together with the second step of the present claim 1. Therefore, the combination of the first step

and the second step in present claim 1 is totally unobvious to a person skilled in the art even in view of Mukherjee, Wagner and Shimada; and KSR (cited by the Examiner) supports this conclusion since a problem is solved to provide unpredicted results not suggested by the combined art of record.

No fees or extensions of time are believed to be due in connection with this amendment; however, consider this a request for any extension inadvertently omitted, and charge any additional fees to Deposit Account No. 26-0084.

Reconsideration and allowance is respectfully requested.

Respectfully submitted,



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